alberta pork production handbook

Agdex 440/41-1
August 1990

Alberta
AGRICULTURE
Pork Industry Branch

THE ALBERTA SWINE IMPROVEMENT PROGRAM

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A. History

Programs to improve and select superior swine breeding stock have been operating in Canada since the 1930s when Agriculture Canada established the "Advanced Registry" system and central swine test stations. These progeny test programs were too slow for really effective improvement of breeding stock. During the 1960s the name changed to Record of Performance (ROP). In the early 1970s, there was a switch in emphasis from the progeny test to individual boar and gilt testing on farms and in test stations. Along with this came use of ultrasonic backfat measurement machines which made painless fat measurement quick and easy. Many pigs could now be tested quickly and more meaningful selection resulted. In the 1980s, a sow productivity recording component was added to the program and the name was changed again to the Swine Improvement Program. True genetic evaluation began with the advent of computers, which permitted genetic and environmental influences to be determined separately.

B. Purpose

The physical production unit in the swine industry is the breeding herd. While most pigs grow, deposit lean tissue, reproduce and are structurally sound and healthy, for improvement of pigs, it is necessary to obtain breeding stock that shows superior performance in these basic characteristics. Once this superior base is in place, it becomes a management function to realize the potential performance of the stock.

Traits such as growth rate, carcass leanness (measured indirectly as backfat) and reproductive rate can be measured easily with an accurate and uniform measurement system. The Alberta Swine Improvement Program is part of the Canadian Swine Improvement Program which operates in all provinces. It provides a measurement system to identify superior pigs for carcass lean, growth rate and sow reproductive characteristics. Specifically, the objectives of the Canadian Swine Improvement Program are:

- to provide a meaningful herd testing system, which will permit identification and ranking of individual pigs according to their relative genetic merit,
- to develop an industry structure which will facilitate optimum use of genetically superior pigs in the national herd.

C. Theory

Visual differences between individual animals (also called phenotypic variation) are a result of differences between the genetic makeup of the individual and the environment they are placed into. The influence of genetics and environment varies among the different traits. The amount estimated due to genetics is called heritability, which is often expressed as a percentage of total variation. Estimates for various traits are presented in Table 1.

Table 1. The effect of heritability and environment

Trait	Heritability %	Environment %
Backfat	50	50
Growth rate (post-weaning)	30	70
Number farrowed per litter	10	90
Number weaned per litter	10	90
Weaning weight of litter	20	80

All figures are approximate. Adapted from J.F. Lasley *Genetics of Livestock Improvement*, 1978 (averages and estimates can vary widely).

Those traits that are moderate to highly heritable (backfat and growth) can be improved by selecting individual superior animals.

Traits of low heritability (litter size and weaning weight) do not respond well to individual selection. In the latter case, superior performance must be assessed by sow line or family performance. Performance in these traits can be enhanced effectively by cross-breeding.

D. Industry structure

The industry structure to achieve genetic improvement in the highly heritable male traits of backfat and growth rate is shown in Figure 1. Most of the testing occurs in the group at the centre of the diagram called "Breeders". Here superior performing sires and dams are identified in all the herds on the program. Two criteria are needed to make across herd comparisons possible. First, a uniform identification system that provides a unique identity for every pig on the program. That is provided by the Livestock Pedigree Act and recorded by the Canadian Livestock Records Corporation. The second is an 'across herd' evaluation system.

The new estimated breeding value (EBV) system currently available for performance traits makes across herd evaluation possible (See *Estimated Breeding Values*, Agdex 440/41-2). The best performing boars and gilts are mated and the boar progeny are sent to the test station. The best performing boars that are structurally sound at the test station are potential candidates for the AI unit. Seedstock (and commercial) producers can obtain these superior genetics to further enhance backfat and growth rate and the cycle is repeated over and over. This system is now the preferred route for genetic improvement because it eliminates the health risk and cost of moving live animals from farm to farm.

When sow productivity EBVs become available, a similar industry structure will be necessary to improve those traits. In this case, all testing will be done on farms. Sires and dams that are superior for these traits will be mated and boar progeny will be chosen directly from farms and put in the AI units. The possibility will then exist to select sires on the basis of male and/or female traits. A system for genetic improvement with minimal health risks will exist because transfer of genetic material will be by semen and not live animals.

The goal of both of these systems (performance and sow productivity systems) are to develop specialized sire and dam lines either on a breed basis or even within a breed. The colored breeds (Hampshire and Duroc) have traditionally excelled in the carcass traits. But, these breeds have traditionally been inferior to the white breeds in reproductive traits. It is logical to work on the strengths of each breed and try to enhance those. The result will likely be that the colored breeds will be selected for leanness and fast growth and the white breeds will likely be selected primarily for reproductive traits (litter size, weaning weight, mothering ability, farrowing interval). In the white breeds, there could be some secondary selection for leanness and growth rate. The advantage of two sets of EBVs is that the breeder can improve his stock in any directions that is deemed advantageous.

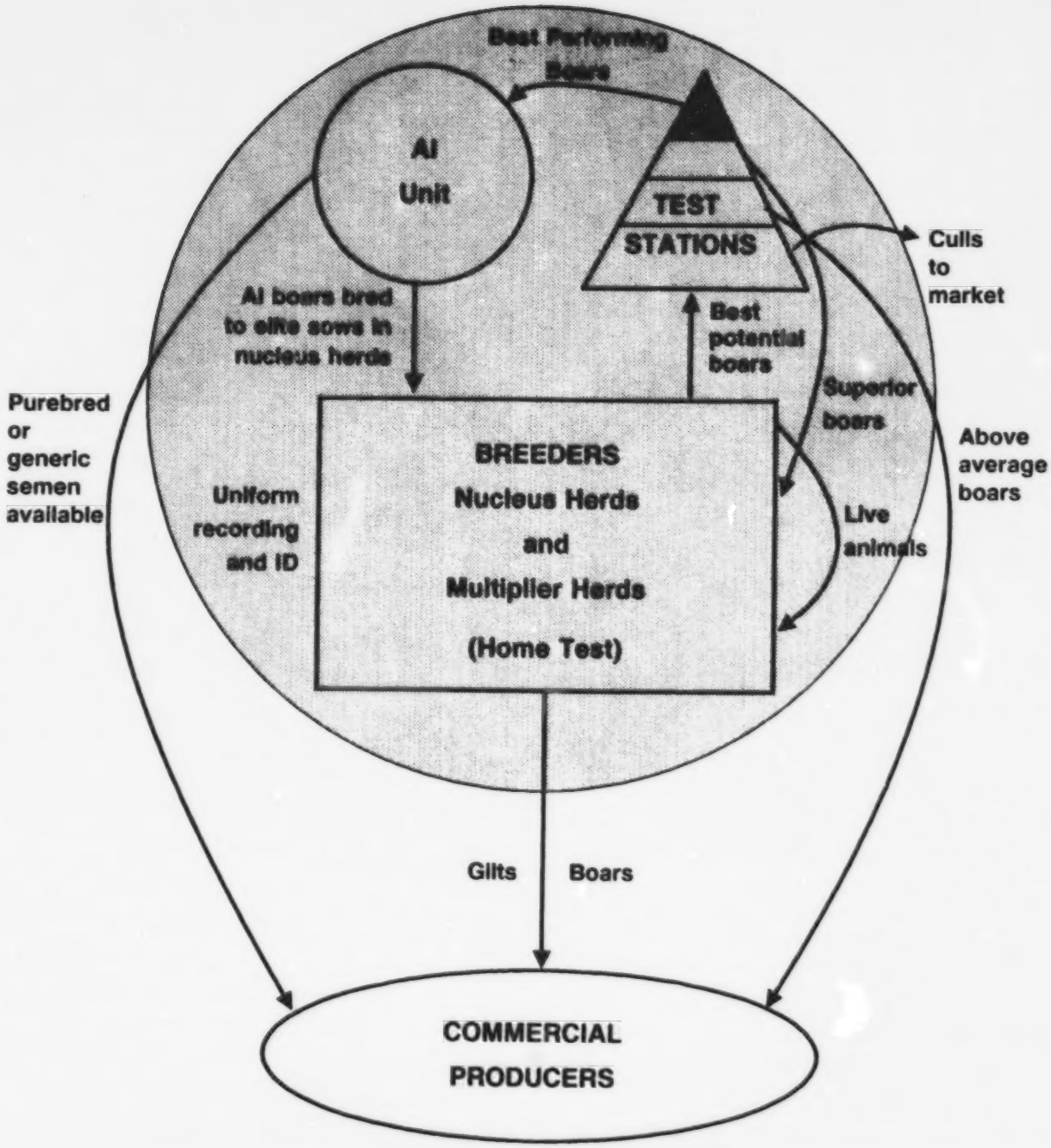


Figure 1. System for genetic improvement of backfat and growth rate (Main cycle of genetic improvement is in the shaded area)

E. Operation

There are three components to the swine improvement program:

- Home (farm) testing,
- Station testing,
- Sow productivity & management program

Home (farm) testing
The majority of pigs are tested at home (about 20,000 per year). Participating breeders are encouraged to test all available young boars and gilts to determine which animals are worth keeping from a genetic standpoint and which ones should be culled. Farm testing is done by provincial technicians.

The home test program is open to seedstock producers, breeding companies or commercial operators. There is a fee for this service and current rates are available from the pork industry branch in Edmonton at 427-5319. The home test program is divided into two parts, as follows:

- Seedstock section - This section is designed for producers or companies who are in the business of raising breeding stock and selling it to others. These may have either purebred (registered), straightbred (unregistered) or crossbred pigs. The herds enrolled in this section must have their litter cards verified by the provincial technicians and have their data published in the provincial probe report.
- Commercial section - This section is designed for commercial producers who wish to have a meaningful system for selecting replacement gilts. There is no litter card verification and no data publication.

To be eligible for home testing, seedstock producers, commercial producers or breeding companies must:

- Own and maintain a swine breeding herd of identifiable ancestry (i.e. pigs must have acceptable identification numbers or letters, and records of sire and dam identity must be present),
- Identify each pig that is to be tested by tattoo, ear notch or ear tag before litters are weaned,
- Maintain a complete and accurate breeding record of all litters using the sow litter cards supplied by the pork industry branch. On these cards, the sire, dam and individual pig in each litter, and the litter birthdate must be identified. It is recommended that other data outlined on these cards also be kept,
- Provide an accurate scale and satisfactory crate for weighing pigs,
- Performance test all intact boars and gilts that are retained as potential breeding stock at 75 to 105 kg liveweight.

The effort and extra cost involved in tested pigs is wasted if environmental influences are allowed to overshadow genetic influences. Environmental variation must be kept to a minimum, otherwise a potentially superior pig may appear to be inferior because of bad management, ill health or poor nutrition.

When a producer registers for the swine improvement program and satisfies all the qualification, a technician will vist his farm to test the animals. The technician will use an ultrasonic backfat tester to measure the backfat at four locations on the pig's loins. These positions are located directly above the curve of the pig's last rib on each side 5 cm lateral to the spine. A second pair of measurements are taken about 15 cm to the rear of these positions. These locations were carefully selected through research as the best predictors of carcass leanness when measured on the live animal. None of these locations are the same as that used by the grading gun in the packing plants. The grading site was chosen because it is readily measurable in a packing plant and gives the best indication of lean meat yield on the carcass. Both methods of measurement have about 60 per cent accuracy for predicting carcass leanness. The equipment used to measure backfat on live pigs and its method of use are shown in Figures 2, 3 and 4.

Figure 2. Ultrasonic backfat tester

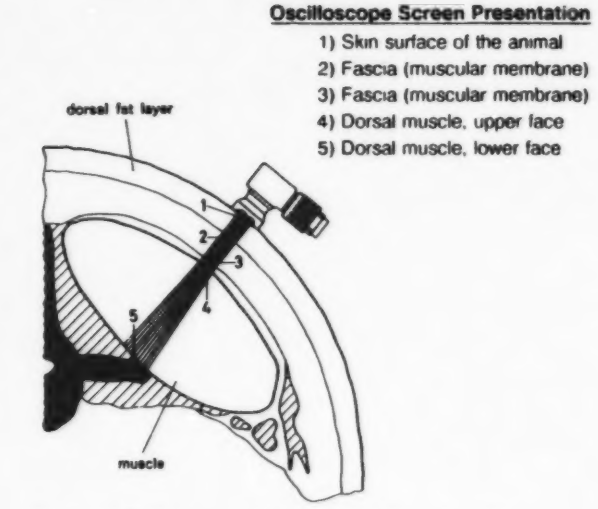


Figure 3. Crossection of loin showing fat measurements

Tissue depth readings are read directly in mm on the screen at the left side of each break.

1) Skin surface of the animal
2) Fascia (muscular membrane or 1st false lean)
3) Fascia (muscular membrane or 2nd false lean)
4) L. Dorsi muscle, upper surface
5) L. Dorsi muscle, lower surface

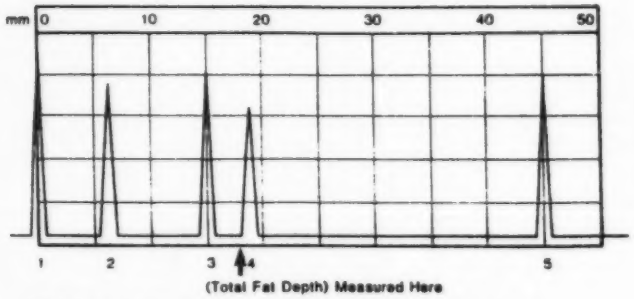


Figure 4. Oscilloscope screen presentation

When potential breeding stock (young boars and gilts) reach a weight of 75 to 105 kg, they are weighed and backfat is measured and recorded. The data are calculated as explained in the "results" section of this factsheet.

Station testing

The test stations are open to all herds enrolled on the home test portion of the program. Producers wishing to enter pigs must also be enrolled on the provincial swine herd health program and be declared free of serious infectious diseases by the supervising veterinarian. Boars enter the station between 20 and 30 kg. They are on test between 30 and 90 kg on a special test station ration. At 90 kg, they are weighed and the following off test measurements are taken:

Backfat — measured at the same four locations as in the home test and adjusted to 100 kg.
Average daily gain (ADG) — measured for the test period of 30 to 90 kg.
Age — days from birth adjusted to 100 kg.
Feed conversion — measured for the littermate pair between 30 and 90 kg (Note: this is an indication of feed conversion only, it is not an accurate figure for each boar because it is an average for two or more boars per pen).

Estimated breeding values (EBV) and an index are then calculated as explained in the results section.

Sow productivity and management program

Early in the 1980s, Canada had no national system to record reproductive performance of individual sows in breeding stock herds. Sow reproductive performance includes litter size (total born and born alive), number weaned, litter weaning weight and farrowing interval. Since these maternal traits are important for a successful hog operation, a computerized recording system was instituted to monitor these. Also, there was concern that some gilts may have been selected to the point of being too lean to be reproductively sound over seven or eight parities (pregnancies).

Under this program, producers enrolled on the home test portion of the program send in breeding, farrowing and weaning data on individual sows. These are entered into a computer and the sow's productivity over all her litters is calculated on the previously mentioned traits. Herd summaries are also generated. This information will form the basis for the sow productivity EBV systems which is being developed and will be calculated on:

- total number of pigs born per litter
- number of pigs born alive per litter
- number of pigs weaned per litter
- litter weaning weight
- farrowing interval.

F. Results

Home test

After each boar and gilt is weighed and its backfat measured in the participating producer's barn, the following data is entered into a computer for each pig tested. Data entry and calculations are done right on the farm so the farmer has immediate results.

Data entered:

- breed
- dam identification
- sire
- birthdate
- dam parity (optional)
- litter size (number born alive - optional)
- pig identification
- weight in kg and probe in mm
- each of four backfat measurements (in mm)
- probe date

A partial report generated by the program is attached as Table 2. The letters in the explanation correspond to those in the report.

Phenotypic measurements

[a] Adjusted backfat — this is the average of the four backfat measurements adjusted to 100 kg (220 lb) to simulate market weight. This figure is a mix of genetics and environment and should not be used for selection purposes.

[b] Adjusted age — this is the adjusted number of days from birth to 100 kg, likewise a mix of environment and genetics.

Genetic evaluation

[c] EBV for fat — for the pig to be better than average, it must have a negative EBV, the larger the negative number the better (see EBV fact sheet for more information).

[d] EBV for age — this is the genetic assessment for age. Again, it should be a negative number.

[e] Repeatability % — this is an indication of how accurate the EBV's for age and backfat are; depending on how much information is available, these will range between 35 and 60%.

[f] Index — this is a ranking combining the EBV for backfat and the EBV for age into one number. The average index for each breed and sex is 100. Pigs that index over 100 are genetically better than average. Those under 100 are worse than average. The index follows the normal distribution curve found on page seven.

Agriculture Canada
Alberta Agriculture

Home Test - Probe Report by Sex - Pig ID

Breeder: 0692 WEBER FMS LTD.
BOX 477
CASTOR, ALBERTA
T0C 0X0

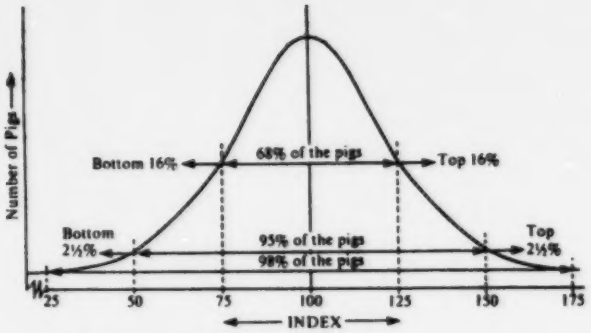
Probe Dates: 90/06/07 - 90/06/07

Technician: 0003 RUSSELL BONAK, RED DEER 340-7603

Sire Id	AI	Dam Id	Breed Code	Pig Id	Sex	Dam Par.	Lit. Size	Birth Date	Adjusted Test Data Average Fat [a]	Age [b]	Estimated Breeding Values Fat [c]	Age [d]	Rep. [e]	EBV Index [f]
AMGF 25Y		AMGF 71Y	Y	AMGF 24Z	M	1	8	90/01/04	13.5	171	-1.0	2.7	50	107
AMGF 25Y		AMGF 71Y	Y	AMGF 27Z	M	1	8	90/01/04	10.4	169	-2.1	1.9	50	131
AMGF 875I		AMGF 793I	Y	AMGF 87Z	M	2	11	90/01/19	17.5	165	1.2	1.1	50	75
AMGF 1024I		AMGF 871I	Y	AMGF 106Z	M	2	9	90/01/20	17.0	153	1.6	-5.0	50	90
AMGF 1024I		AMGF 871I	Y	AMGF 107Z	M	2	9	90/01/20	17.4	149	1.8	-6.5	50	93
AMGF 25Y		AMGF 100Y	Y	AMGF 884Y	M	1	10	89/12/24	11.2	172	-1.8	1.8	50	126
AMGF 25Y		AMGF 100Y	Y	AMGF 885Y	M	1	10	89/12/24	12.2	171	-1.5	1.5	50	121
AMGF 25Y		AMGF 100Y	Y	AMGF 886Y	M	1	10	89/12/24	11.1	166	-1.9	-0.4	50	135
AMGF 1024I		AMGF 794I	Y	AMGF 906Y	M	2	8	89/12/26	12.0	159	-0.9	-3.8	50	131
AMGF 1024I		AMGF 792I	Y	AMGF 922Y	M	2	6	89/12/27	13.8	164	-0.3	-1.6	50	111

** Note: Fat and age are adjusted to 100 KG.

Table 2. Home test results



100 Index is average for the herd by breed and sex
68% of the pigs should fall between 75-125 Index
95% of the pigs should fall between 50-150 Index
98% of the pigs should fall between 25-175 Index

Figure 5. Index distribution

A *Provincial Probe Report* is published every month which shows the complete data for each boar tested in seedstock herds and summarizes the data for the gilt tested. It is a valuable aid for commercial producers looking for quality breeding stock. These reports are available from regional swine specialists, district offices of Alberta Agriculture or free of charge by mail from the pork industry branch in Edmonton. Phone 427-5319 to get on the mailing list.

Station test results

A sample of a test station probe report is attached as Table 3. The data calculated are similar to home test except that the EBV for age at the test station is based on the average daily gain (ADG) on test. Age and feed conversion figures are for information only. They are not used in any calculation.

Phenotypic measurements

- [a] Adjusted age — the days from birth to 100 kg (220 lb) to simulate market weight.
- [b] Adjusted fat — the average of the four backfat measurements adjusted to 100 kg.
- [c] Daily gain — the actual daily gain on test between 30 and 90 kg.
- [d] Feed conversion — the average feed conversion for the two or more boars per pen.

Genetic assessment

- [e] EBV for fat — to be genetically better than average, this must be a negative number; the larger the negative number, the better.
- [f] EBV for age — to be genetically better than average, this has to be a negative number.
- [g] Repeatability (Rep) — this figure is in per cent (%), it indicates how accurage the EBV for fat and age are; repeatability ranges from the high 30s to the high 50s depending on how much information is available on the pedigree of the tested boar.
- [h] EBV index — the ranking which compares a particular boar to all boars of the same breed in the region, based on the same curve shown under home test; boars above 100 index are better than average for the backfat and growth rate.

Probe Dates: 90/07/06 - 90/07/06

Technician: LAJOS HAJDU, EDMONTON 427-5319

Sire Id	A I	Dam Id	Breed Code	Pig Id	Sex	Dam Par	Lit. Size	Birth Date	Adjusted Test Data Age	Fat	Daily Gain	Feed Conv	Estimated Breeding Val Fat	Age	Rep.	EBV Index
									[a]	[b]	[c]	[d]	[e]	[f]	[g]	[h]
Owner: 0003 FIVE LAKES FMS.																
JKAA 1602W		JKAA 3011W	Y	JKAA 33017	M		10	90/02/16	143	13.0	1.30	2.06	-0.3	-5.9	57	128
JKAA 1602W		JKAA 3011W	Y	JKAA 33027	M		10	90/02/16	146	14.7	1.20	2.06	0.3	-2.7	57	105
Owner Averages:		2 Pig(s)							145	13.9	1.25	2.06	0.0	-4.3	57	117
Owner: 0004 G. MATEJKA																
KKEF 1013I		KKEF 1823I	Y	KKEF 1247	M			90/02/18	146	10.6	0.98	2.20	-2.2	-3.3	51	152
KKEF 1013I		KKEF 1823I	Y	KKEF 1252	M			90/02/18	139	13.6	1.08	2.20	-1.1	-6.4	51	144
KKEF 1013I		KKEF 2501U	Y	KKEF 1602	M			90/02/12	156	11.1	1.02	2.05	-1.6	-2.9	47	141
KKEF 1013I		KKEF 2501U	Y	KKEF 1612	M			90/02/12	146	10.7	1.10	2.05	-1.8	-5.4	47	153
Owner Averages:		4 Pig(s)							147	11.5	1.05	2.13	-1.7	-4.5	49	148

Table 3. Station test results.

Test station boar sales
At the end of every test station fill, the Alberta Swine Breeders Association (ASBA) operates an auction sale of all the boars that are above average (over 100 index) and that are physically sound. Sales are held on the second Friday of every month alternating between the Leduc and Lacombe test stations. An advance report is published two weeks before each sale and is available free of charge. Phone the ASBA office or the pork industry branch in Edmonton to get on the mailing list.

G. Application of results

When hog producers wish to purchase breeding stock, there are several factors besides cost that should be considered before the purchase is actually concluded. The important factors are:

- Health status of the herd that the breeding stock is to come from and its relation to the herd of destination — The health status of these two herds should be similar. The health status of the originating herd may be somewhat better than the destination herd but definitely cannot be worse. Information on the herds participating in the Alberta Swine Herd Health Program is available from health management branch of Alberta Agriculture in Edmonton. Some herds are enrolled on private veterinary programs and information on the herds can generally be provided by the supervising practitioner.

- The performance potential of the individual animals to be purchased.

- Physical soundness and suitability — The buyer can make this assessment in many cases. Sometimes this is not possible owing to health restrictions or distance, and the seller will have to be entrusted with this task.

Superior performing breeding stock can be identified with the help of the swine improvement program. For a list of sources of breeding stock, consult the Alberta Agriculture factsheet *Sources of Swine Breeding Stock*, Agdex 440/38-2. The following steps are recommended once the decision regarding health status has been made.

Boar selection
Determine the breeds or crossbreds that fit into your intended breeding program.

Use a recent *Provincial Probe Report* or test station sale notice to select boars that are leaner and faster growing than the average for the breed. Look for a negative EBV in the fat and age columns, the larger the negative number, the better. The EBV index should be over 100, and the greater the positive number, in this case, the better.

Gilt selection
To select gilts that are prolific and produce good breeding offspring, the emphasis is different from that used in selecting boars. First, select those breeds or crossbreds that are the best for litter size and weaning weights. These are usually the white breeds — Yorkshire, Landrace and Lacombe. A crossbred gilt (e.g. Yorkshire x Lacombe) may have about a 5 to 10 per cent performance advantage over the parental lines if it exhibits hybrid vigor or heterosis. Hybrid vigor is also exhibited when crossbred gilts have better stamina to stand up in modern intensive hog operations than their purebred parents. To obtain crossbred gilts, or more precisely, F1s (the first generation cross between pure parents of different breeds) the hog producer can ask a supplier to produce a particular cross or the producer can create them by buying pure parent lines. It is advisable to buy boars and gilts from the same source to minimize health risks. A crossbred gilt will not necessarily exhibit hybrid vigor; it is more likely to do so if its parents are from high performing lines of different breeds.

Some buyers expect inbreeding problems from buying all their stock from one source. Usually this is not a problem since most breeders have enough lines of stock to prevent inbreeding. Besides, reliable breeders keep manual or computer records of what they sell to each purchaser to prevent mating of related stock.

Once you have decided on your breed preference, look at the *Provincial Probe Report* to see which breeders produce the breeds you're looking for and contact them to get information about their sow productivity status. If possible, find out which are their most productive lines and choose the best performing progeny from these lines. In the Provincial Probe Report, individual pig performance for gilts is not reported owing to the large numbers tested. A summary line is provided for each breeder to provide an overall indication of performance. Performance figures for gilts from individual breeders are available from the pork industry branch in Edmonton at 427-5319. Specific crosses are not identified on the report, all crossbreds and F1s are grouped together as

"commercial". You will have to call individual breeders to determine what crosses they have available.

Contact the breeder and ask if your choice(s) are available, what they're like physically and at what price. You may wish to go look at the stock yourself to assess structural soundness and suitability this may not be possible if the originating breeder's herd does not allow visitors. In this case, you will have to rely on the breeder's judgement. Usually this is not a problem because most breeders guarantee their breeding stock. Before buying breeding stock, find out what the breeders guarantee really is, how long he's been in business and what his reputation is according to other producers.

Look at performance figures before selecting breeding stock. If selection is made on the basis of appearance, the tendency is to buy the stock regardless of performance figures.

H. Definitions

Alberta Swine Breeders Association - A group of swine breeders whose common purpose is to raise breeding stock of superior quality for sale to commercial producers.

Canadian Livestock Records Corporation (CLRC) (formerly Canadian National Livestock Records (CNLR) - The agency that registers purebred pigs for the various swine breeds in Canada.

Crossbreeding - The mating of animals which belong to different breeds.

Culled - That which is sent to slaughter or discarded in the selection process for some reason.

Environment or Environmental Influence - All external conditions and influences, except genetics, which affect an animal's performance or behavior; these include housing, feeding, handling, breeding, etc. (all those factors whereby people, location and climate can influence an animal's performance and behavior, usually expressed as a percentage: environment plus genetics = 100% for any trait.

Estimated Breeding Values (EBV) - A genetic evaluation system which attempts to measure the actual genetic capability of an animal for a specific trait (usually compared to a breed average).

F1 - The first generation cross between two pure parents of different breeds.

Farrowing Interval - The number of days between litters for a sow (approximately 150 days).

Genes - The actual units of inheritance from parent to offspring, they are on the chromosomes which are located in the nucleus of each cell of each plant or animal.

Genetics - The science that deals with the laws and processes of inheritance (i.e. the transmission of genes from parent to offspring and their effect on an animal's life.

Genetic Selection - The selection of breeding stock for genetic reasons. Because genetic value is not apparent to the naked eye or simple observation, a system is necessary to assess genetic merit (e.g. EBV).

Genetic Competition (between herds) - The rivalry between herds producing breeding stock to determine who can attain the best genetic quality.

Genetic Progress - The amount of measurable genetic improvement in a trait that occurs over a certain period of time.

Genetic Trend - The amount and direction (positive or negative) of change in a trait in a breed.

Heritability - That portion of an animal's total makeup and performance that is determined by its genes, usually expressed as a percentage (this plus environment equals 100% for any trait).

Hybrid Vigor - (Heterosis) - The phenomenon of increased vigor or performance in certain traits over the parents when two breeds or lines are crossed.

Home (Farm) Testing - The testing that each producer registered on the swine improvement program has done at his farm, presently that is for backfat and growth rate; sow productivity information is also recorded.

Inbreeding - The mating of closely related pigs, sometimes done for several generations, to enhance valuable traits. It also can result in the expression of undesirable traits and has a negative effect on reproductive traits.

Littermates - Two or more pigs from the same litter.

Pedigree - A list of an animal's ancestors; this may be kept by the owner only or can also be registered by Canadian Livestock Records Corporation if the animal is purebred and meets all the requirements for that registration.

Phenotype or Phenotypic - The observed character of an individual without reference to its genetic nature (animals may look the same phenotypically but perform quite different genetically).

Progeny - The offspring of an animal.

Purebred - An animal that belongs to one of the recognized breeds as established by a breed association and is registered in the herdbook maintained by the Canadian Livestock Records Corporation.

Seedstock - The breeding animals (sows and boars) on a farm.

Sibs - The full or half brothers and sisters of an animal.

Sow Productivity - Those traits which are primarily attributed to the sow such as litter size, weaning weights and farrowing intervals.

Straightbred - An animal within a recorded line of ancestry kept by the owner and within a recognized breed but not eligible for registration by the Canadian Livestock Records Corporation.

Test Stations - Barns built especially to feed pigs in small groups, a specific ration for a specified time to measure specific traits. In Alberta, there are 2 boar test stations (at Leduc and Lacombe) which measure growth rate and backfat on boars between 30 and 90 kg.

Traits - A certain characteristic which is part of an animal's total being.

Ultrasonics or Ultrasonic Backfat Measurement - The technology that uses high frequency inaudible sound emissions to measure backfat; it is relatively quick and easy to do by a trained operator; it does not hurt or harm the animal being measured in any way. Machines that do this on pigs cost between $600 and $10,000.

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